On the Oral Appendages of certain Species of Marine Isopoda.

By Walter E. Collinge, D.Sc., F.L.S., Carnegie Fellow, and Research Fellow of the University of St. Andrews, the Gatty Marine Laboratory, St. Andrews.

(Plates 7–9.)

[Read 3rd May, 1917.]

Contents.

I. Introduction.

There are few groups of animals that present greater difficulties in connection with their classification than the Order Isopoda.

Much of the work of the earlier carcinologists has, in the light of recent research, proved to be very imperfect, and many of the genera and species classified as related to one another have been shown to be widely separated. Further, structural characters that hold good for certain divisions of the Isopoda are quite unsatisfactory for others. This is particularly well illustrated in the oral appendages. I have elsewhere (7) expressed the view, and shown, that in the suborder Oniscoidea, Sars, these appendages "are liable to a large amount of variation in individual species, and are therefore characters of only minor importance as compared with the form of the head, antennæ, telson, uropoda, mesosomatic segments, and thoracic appendages," and I believe that further investigations will serve to corroborate and strengthen this view so far as the strictly terrestrial forms are concerned, where considerable modification and degeneration have taken place.

On the other hand, in certain suborders of marine Isopoda these same appendages would seem to be fairly constant in form, and to offer excellent data for the characterization of both genera and species (8–12).

Recent work on the suborder known as Valvifera shows that the form of at least two of the four oral appendages affords most valuable aid in the discrimination of both genera and species, viz., the first maxillæ and the maxillipedes. In this connection it is interesting to note, that in the members of the family Idoteidæ they differ very little in the immature stages from that obtaining in the adult; they are thus frequently of great service for purposes of identification. A further interesting point relative to the two pairs of maxillæ, and in a lesser degree the maxillipedes also, is the frequency with which the "casts" of these appendages remain attached to the newly formed ones, and they often serve a useful purpose in aiding in the elucidation of minute structural details, as, being free from all muscular attachments and almost void of pigment, they can easily and quickly be made transparent.

It is therefore much to be regretted that many authors have given no description or figures of the form and structure of these appendages in quite a large number of species.

In the present communication I have endeavoured to remedy this to some extent by describing and figuring the first maxilla (occasionally the second) and the maxillipede in 24 species referable to 9 genera of the family Idoteidæ, in none of which, so far as I am aware, have they both been described, and also to correct some errors in a few of the figures and descriptions where the maxillipede only has been partly described and incorrectly figured.

I have much pleasure in here expressing my thanks to the authorities of the U.S. National Museum, Washington, for specimens of many of the species examined; to Professor D'Arcy W. Thompson for examples of *Mesidotea sabini* (Kröyer); to Professor Chas. Chilton for various New Zealand species; to Mr. Keppel H. Barnard for many South African species; and to Mr. Walter H. Baker for South Australian species.

Under the different species the more important references have been given, but no attempt has been made to give the complete list of synonyms or references.

II. Method of Preparation.

Most of the errors in previously published figures and descriptions of the oral appendages of the Idoteidæ are due to the fact that the different segments, joints, spines, etc. are not always shown, and this has no doubt partly arisen owing to the appendages having been imperfectly prepared for microscopical examination.

The old method of boiling or even soaking in a solution of caustic soda is unsatisfactory, as frequently the different parts become separated from one another and also become altered in form to a greater or lesser degree.

After considerable experimentation, I think I have at last arrived at a method that is thoroughly satisfactory. So far as I am aware, the details have not previously been published; it therefore seems desirable to describe the method in detail.

The original idea of treating chitin as described below is Professor J. C. Irvine's, who adopted it in a research on the chemical nature of chitin derived from different sources *. He has very kindly given me the essential details of the process, and with these I have made numerous experiments and modifications, ultimately evolving the following process for clearing and staining small chitinous objects, such as the appendages and other parts of the exoskeleton of crustacea.

All the material dealt with had previously been preserved in alcohol. Upon removing the appendage or particular part to be studied, it was placed in a small quantity of a 15 % solution of HCl, and there allowed to remain for a period varying from twenty minutes to three hours, according to the size and thickness of the object. The receptacles used for containing the specimens and fluids were small flat glass dishes $39 \times 39 \times 9$ mm. with a circular concavity 5 mm. in depth, and covered with a square of glass. Upon removing the specimen from the HCl it was well washed in distilled water and then transferred to a 5 % solution of caustic soda, in which it was allowed to remain for one to three hours, and then placed in a 4 % solution of sodium permanganate for a period varying from thirty minutes to two

* Trans. Chem. Soc. Lond. vol. xcv. (1909) pp. 564–570.

hours. Finally, it was again placed in a 15 % solution of HCl for ten to sixty minutes. After further careful washing the specimen was dehydrated and then stained with Meyer's alcoholic carmine.

Most of the material was examined in xylol, some was mounted in Canada balsam (xylol) and some in Farrant's solution, but none of the specimens were improved by the use of either of these media—the former proved the better of the two.

I should strongly recommend anyone trying this method to first experiment with some material of no value, as it is only by experience that one comes to appreciate just the right time to remove the specimens from one solution to another. If removed too soon little change has taken place ; on the other hand, a very short excess period is sufficient to ruin the object.

If the above-mentioned small flat glass dishes are used the specimens can be examined from time to time under a low-power of the microscope and the progress and changes noted.

The value of this method of treating small, jointed chitinous objects lies in the fact that, if carefully handled, little or no displacement of the different parts takes place ; further, the objects are rendered perfectly transparent, all cellular tissue and pigment being removed, and a uniform stain is taken up by the margins of all joints, segments, spines, etc. Setæ which appeared to arise as stiff spines from the surface of a body can, by this method of preparation, be seen to pass beneath the surface at their proximal ends and to be lodged in tiny pits or articular cups, whilst others that appeared to be perfectly smooth are found to carry smaller spines, teeth, etc.

It is with considerable pleasure that I here acknowledge my indebtedness to Professor Irvine for the basis of this method, and for the, at all times, kindly criticism and advice he has given.

III. The Oral Appendages of the Family Idoteidæ.

The two principal appendages that have been employed in the classification of the members of the suborder Valvifera are the first maxillæ and the maxillipedes, and I propose to offer some few remarks upon these as presented in the family Idoteidæ.

The First Maxillæ.—Each maxilla consists of a pair of elongated chitinous bodies—the inner and outer lobes—connected by a small basal segment. The outer lobe is slightly convex on the ventral side and almost flat dorsally, usually the anterior half, or even two-thirds, is wider than the posterior portion. Setules, small plain spines, set in cup-shaped articular cavities may or may not be present on the anterior part of the ventral surface. Distally there are a variable number of curved spines. In many species these are divided into two distinct sets, viz., an outer series of stout, curved, bluntly

pointed ones, and an inner series of thinner, more slender, usually sharply pointed ones, which have one or more rows of teeth on their sides, which vary considerably in number and size. The two series are frequently separated by a long, slender, sharply pointed spine. There are often a series of setæ on the anterior outer (and sometimes inner) border.

The inner lobe shows considerable variation in the different genera. It consists of an elongated, narrow, posterior portion, which widens anteriorly into an oval or more or less triangular, flattened plate, with two to four setaceous spines at the distal extremity, in addition to which, one or more setules may be present. In a few cases the number of setaceous spines may be greater on the appendage of one side than on that of the other.

The Maxillipedes.—Each maxillipede consists of a divided coxopodite, a basipodite with a short inner lobe on the inner side, and an outer lobe or palp (endopodite) articulating with the basal segment on the outer side. On the outer side posteriorly there is a wide, more or less oval, plate, the epipodite. The divisions of the coxopodite lie respectively posterior to the epipodite and basipodite. The inner lobe of the basipodite is generally fringed distally with a number of setose and plain spines, and on its inner side and about its middle is a curved process which serves to hook together the appendages of the two sides. Occasionally there are two or more of these processes.

The outer lobe or palp is composed of a varying number of joints, but the first or "collar"-joint, a short one immediately anterior to the basipodite, is, I believe, present in most genera. It would seem to be absent according to Miss Richardson (21) in the genus *Chiriscus*, for no such joint is shown in the figure of the maxillipede of *Chiriscus australis*, Richardson.

In *Edotia*, Guérin-Mén., *Synidotea*, Harger, *Chiridotea*, Harger, and *Macrochiridothea*, Ohlin, there are three joints in the palp of the maxillipede; in *Idotea*, Fabricius, *Erichsonella*, Benedict, *Colidotea*, Richardson, *Eusymmerus*, Richardson, *Synisoma*, Collinge, and *Euidotea*, Collinge, four joints are present; whilst in *Crabyzos*, Spence Bate, *Mesidotea*, Richardson, *Pentidotea*, Richardson, *Pentias*, Richardson, *Zenobiana*, Stebbing, *Glyptidotea*, Stebbing, *Paridotea*, Stebbing, *Cleantiella*, Richardson, and *Engidotea*, Barnard, there are five divisions in the palp.

It is very doubtful whether the structure of these parts indicates in any way the phylogeny of these crustacea. In any attempt therefore to estimate the value of these appendages for purposes of classification due consideration should be paid to the segmentation of the metasome, and also to any evidences of degeneration or special modification.

It may be interesting to roughly classify the known genera according to the segmentation of the metasome and the number of joints of the palp of the maxillipede.

The primitive Idoteidæ, in all probability, possessed a metasome composed

of five distinct segments and a palp on the maxillipedes having five joints. Such a type is probably represented by *Proidotea*, Racovitza and Sev., although the maxillipedes have not been seen of this extinct genus. *Mesidotea*, Richardson, would follow, and then *Chiridotea*, Harger, where a segment of the metasome has become fused, but a suture remains indicating it. Although undoubtedly related to the former genus, the palp of the maxillipede is composed of only three joints. The position of *Macrochiridothea*, Ohlin, and *Chiriscus*, Richardson, is somewhat doubtful.

In a second group we have *Pentidotea*, *Zenobiana*, *Glyptidotea*, *Paridotea*, *Pentias*, *Crabyzos*, *Cleantiella*, and *Engidotea*, in all of which genera the palp of the maxillipede possesses five joints. In *Zenobiana* there is often a metasome composed of five segments, and in all the remaining genera there are indications of four segments.

In a third group must be placed *Idotea*, *Colidotea*, *Eusymmerus*, *Erichsonella*, *Synisoma*, and *Euidotea*, all with a four-jointed palp of the maxillipede and one to four metasomatic segments.

Finally, in a fourth group we have *Edotia* and *Synidotea*, each with a three-jointed palp of the maxillipede and a single metasomatic segment and one suture. The Table on p. 71 summarizes these and other structural features.

Whilst there is fairly conclusive evidence to show that the genera of the first group are closely related to one another (*cf.* **19** & **10**), I do not think that it is possible, in the present state of our knowledge, to state that a similar relationship is evident between the genera of the remaining groups.

As I have elsewhere pointed out (**12** *a*), the classification of this interesting family of Isopoda is as yet very uncertain. The known genera and species in all probability constitute only a very small part of those actually existing.

The distribution of the members of this family, which contains some two dozen genera, including about one hundred and twenty-five species, as at present known, is curious. Miers (**16**) and the earlier writers all regarded them as having a wide distribution in all parts of the world, but being more abundant in temperate and colder seas than in the tropics. At that time the majority of species had been obtained in Northern latitudes, but of recent years many new species have been obtained from the Mid and Southern Pacific, Indian Ocean, and Antarctic. Thus, Ohlin (**18**) has described two new species of *Macrochiridothea* and two of *Edotia*, and a new species of *Erichsonella* from South America; Chilton (**5**), the curious *Idotea festiva* from New Zealand; Miss Richardson *, a new species of *Glyptonotus* from the Antarctic; Barnard (**1**, **2**), three new species of *Paridotea* and one of *Synidotea* from South Africa. More recently † I have described a new

* Bull. Mus. Paris, 1906, p. 187.

† Rec. Indian Mus. vol. xiii. (1917) pt. 1, p. 1, pl. i.

species of *Synidotea* from the Indian Ocean, and I have two new species of *Crabyzos* from South Australia, in addition to a number of other forms from tropical localities not yet worked out.

There is no reason to suppose that the South Pacific and Antarctic Regions are any poorer in genera and species than the North Pacific and Arctic Regions, although but few have yet been obtained from the former regions. A careful study, now extending over some years, of the existing forms leads me to the conclusion that future investigations will undoubtedly tend to link together more closely the various genera of this family and the different families of the Valvifera.

As at present known the members of this suborder may conveniently be placed in two groups, viz. :—

i. ASTACILLINEA, nov.

Containing the families Astacillidæ, Stebbing, Chætiliidæ, Dana, and Amesopodidæ, Stebbing.

ii. IDOTEINEA, nov.

Containing the families Idoteidæ, Fabricius, Pseudidotheidæ, Ohlin, and Hologuathidæ, G. M. Thomson.

	1st Maxilla.	Maxillipede.	Metasome.	
	Number of Spines on Inner Lobe.	Number of Joints in Palp.	Number of Segments.	Number of Sutures.
Glyptonotus, Eights	6	5	5	
Symmius, Richardson	....	3 (?)	3	
Chiridotea, Harger	....	3	4	1
Macrochiridothea, Ohlin	....	3		
Mesidotea, Richardson	3	5	5	
Proidotea, Bac. & Sev.	?	?	5	
Chiriscus, Richardson	....	3 (?)	3	
Zenobiana, Stebbing	3	5	3–5	
Pentidotea, Richardson	3	5	3	1
Engidotea, Barnard	2	5	2	2
Cleantiella, Richardson	....	5	2	
Paridotea, Stebbing	3 or 4	5	1	3
Glyptidotea, Stebbing	3	5	1	3
Pentias, Richardson	3	5	1	3
Crabyzos, Spence Bate	3	5	1	2*
Idotea, Fabricius	3	4	3	1
Euidotea, Collinge	3	4	1	3
Colidotea, Richardson	....	4	1	1
Eusymmerus, Richardson	....	4	1	1
Erichsonella, Benedict	3 l. 4 r.	4	1	
Synisoma, Collinge	3	4	1	
Edotia, Guérin-Mén.	....	3	1	1
Synidotea, Harger	2	3	1	

* The second suture is very small in some species, scarcely visible on the dorsal side.

IV. Synoptic Table of the Genera dealt with.

A. Coxal plates distinct on the 3 posterior segments of the mesosome.
  a. Lateral margins of the cephalon entire. Eyes dorsally situated.
    b. Flagellum of antennæ single-jointed.
      c. Metasome composed of 3 segments.
        d. Maxillipedes with a 3-jointed palp ..... *Symmius*, Richardson.

B. Coxal plates distinctly separated on 2nd to 7th segments of the mesosome.
  a. Lateral margins of the cephalon cleft. Eyes dorsally situated.
    b. Flagellum of antennæ multiarticulate.
      c. Metasome composed of 4 segments and 1 pair of sutures.
        d. Maxillipedes with a 3-jointed palp ..... *Chiridotea*, Harger.
      c'. Metasome composed of 5 segments.
        d'. Maxillipedes with a 5-jointed palp ..... *Mesidotea*, Richardson.
  a'. Lateral margins of the cephalon entire. Eyes situated dorso-laterally.
      c''. Metasome composed of 3 segments and 1 pair of sutures ..... *Pentidotea*, Richardson.
      c'''. Metasome composed of a single segment and 3 pairs of sutures ..... *Glyptidotea*, Stebbing.
        Paridotea, Stebbing.
      c'. Metasome composed of 3 segments and 1 pair of sutures.
        d''. Maxillipedes with a 4-jointed palp..... *Idotea*, Fabricius.
      c''. Metasome composed of a single segment and 3 pairs of sutures ..... *Enidotea*, Collinge.
    b'. Flagellum of antennæ single-jointed.
      c'''. Metasome composed of a single segment ..... *Erichsonella*, Benedict.

C. Coxal plates not distinct on any mesosomatic segments.
  a. Lateral margins of the cephalon entire. Eyes situated dorso-laterally.
    b. Flagellum of antennæ rudimentary.
      c. Metasome composed of a single segment and 1 pair of sutures.
        d. Maxillipedes with a 3-jointed palp ..... *Edotia*, Guérin-Mén.
    b'. Flagellum of antennæ multiarticulate.
      c'. Metasome composed of a single segment and 1 pair of sutures ..... *Synidotea*, Harger.

V. List of Genera and Species Examined

Symmius, *Richardson.*

1. Symmius caudatus, *Richardson.*

Symmius caudatus, Richardson, Proc. U.S. Nat. Mus. vol. xxvii. (1904) p. 39, figs. 11–15.

This interesting species was described by Richardson in 1904, from specimens obtained from Japan. The only reference to the oral appendages is in the generic diagnosis, where it is stated "Maxillipedes with a three-jointed palp."

I have previously stated (10) that I question the accuracy of the figures given of this appendage (*op. cit.* p. 41, figs. 13 *a* & *b*). In these two figures Miss Richardson shows a 3-jointed palp; the basipodite, epipodite, and inner distal lobe united; and a very curious form of coxopodite, in all of which characters it is totally unlike the condition obtaining in any other genus of the family.

In the single specimen of this species in my collection, the oral appendages had been removed before it came into my possession. I am unable, therefore, to give a description or figures of either the first maxilla or the maxillipede.

Chiridotea, *Harger.*

2. Chiridotea cæca (*Say*). (Pl. 7. fig. 1.)

Idotea cæca, Say, Journ. Acad. Nat. Sci. Philad. vol. i. (1818) p. 424; Milne-Edwards, Hist. Nat. des Crust. vol. iii. (1840) p. 131; Harger & Verrill, Rept. U.S. Comms. Fish & Fisheries, 1873, pt. i. p. 569, pl. 5. fig. 22.

Chiridotea cæca, Harger, Amer. Journ. Sci. vol. xv. (1878) p. 374; Rept. U.S. Comms. F. & F. 1880, pt. vi. p. 338, pl. 4. figs. 16–19.

Glyptonotus cæcus, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 17.

Chiridotea cæca, Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 353, figs. 380, 381.

The Maxillipede (Pl. 7. fig. 1).—Both Harger and Richardson have figured the maxillipede of this species, but neither describes it. In both instances the figures are incorrect.

This appendage in the genus *Chiridotea* is characterized by the short wide epipodite, small basipodite, and a three-jointed palp, the second joint of which is unusually long.

In this species the whole appendage is extremely short. The coxopodite has the usual two joints of which the outermost is the larger. The basipodite is very small, having a straight inner margin and the outer one slightly expanded. Both the anterior and the posterior margin slope outwardly, but not to the extent shown in Harger's figure. The three-jointed palp is rather

more than two and a half times the length of the basipodite: the first joint is small, the second very long, and the third smaller and more or less oval. Setæ spinous. The inner distal lobe extends forward as far as the middle of the second joint of the palp and has the usual setose and plain spines terminally. The epipodite is somewhat cone-shaped, very short, wider than the basipodite, and has its posterior margin excavate.

3. Chiridotea tuftsii (*Stimpson*). (Pl. 7. fig. 2.)

Idotea tuftsii, Stimpson, Smithsonian Contrib. to Knowledge, vol. vi. (1853) p. 39; Harger & Verrill, Rept. U.S. Comms. F. & F. 1873, pt. i. pp. 340 & 569.
Chiridotea tuftsii, Harger, Amer. Journ. Sci. vol. xv. (1878) p. 374; Rept. U.S. Comms. F. & F. 1880, pt. vi. p. 340, pl. 4. figs. 20–23.
Glyptonotus tuftsii, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 18.
Chiridotea tuftsii, Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 354, figs. 382, 383.

The Maxillipede (Pl. 7. fig. 2).—The single specimen I have examined does not at all agree with either Harger's or Richardson's figures. I have no reason to doubt the identification of the species which was obtained at Cape Cod Bay, U.S.A., in 1879. A reference to the figure shows that in this specimen, whilst preserving most of the characters typical of *Chiridotea*, there are four joints in the palp.

Mesidotea, *Richardson*.

4. Mesidotea sabini (*Kröyer*). (Pl. 7. figs. 3–5.)

Idotea sabini, Kröyer, Nat. Tidsskr. vol. ii. (1846–49) (s. 2) p. 401; G. O. Sars, Arch. f. Math. og Naturvidensk. vol. ii. (1877) p. 350.
Glyptonotus sabini, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 15, pl. 1. figs. 3–5; Richardson, Proc. U.S. Nat. Mus. vol. xxi. (1899) p. 844.
Chiridotea sabini, Stebbing, Ann. & Mag. Nat. Hist. (s. 7) vol. iv. (1899) p. 263.
Mesidotea sabini, Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 350, figs. 377–379.

Kröyer figures both of the maxillæ and the maxillipedes, the former, however, bear little or no resemblance to the actual form. In the first maxilla he shows an outer lobe with eight spines and an inner one with four, whilst in the second maxilla the two outer lobes are shown with four spines on each and a series of bluntly ending ones on the inner lobe. The maxillipede in his lower figure is fairly correct, but wrong in the upper one.

The First Maxilla (Pl. 7. fig. 3).—The outer lobe terminates in eleven spines, most of which are stout, and there are numerous setæ on the outer margin of the lobe, which extend downwards for some distance. The inner lobe terminates in two long setose spines and a small curved setule on the outer ventral border.

The Second Maxilla (Pl. 7. fig. 4).—The two outer lobes terminate in six

and seven long spines respectively, most of these are serrated; the innermost lobe has sixteen to twenty setose spines, varying in size, the last one on the inner margin being the longest.

The Maxillipede (Pl. 7. fig. 5).—In this species this appendage is comparatively small, but of a very robust type and having its margins densely fringed with setæ and spines. The inner division of the coxopodite is small, almost cuboid. The basipodite is also very small, measuring only about half the length of the palp. Its anterior and posterior margins are obliquely cut away, sloping towards the outer margin; the inner margin is fringed with fine, closely-set setæ. The five-jointed palp has the first joint rather larger than in most species, the second joint is comparatively small, the third the largest and with a lobe-like extension on the inner side, the fourth joint is longer than the third, but much narrower, whilst terminally there is a small fifth joint. All the joints are fringed with setæ, which are extra long on the fifth joint. The inner distal lobe extends to the anterior border of the second joint of the palp and is fringed with setose spines terminally. The epipodite is almost circular and extends as far as the middle of the second joint of the palp. It is fringed with short, closely-set setæ.

Pentidotea, *Richardson*.

5. Pentidotea resecata (*Stimpson*). (Pl. 7. figs. 6, 7.)

Idotea resecata, Stimpson, Bost. Journ. Nat. Hist. vol. vi. (1857) p. 504, pl. 22. fig. 7; Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 45.

Pentidotea resecata, Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 369, figs. 400, 401.

The First Maxilla (Pl. 7. fig. 6).—This appendage in this species has not previously been figured or described. The outer lobe terminates in twelve spines, the innermost five of which are denticulate; there is a long fine spine about the middle and then six stout curved spines on the outer side. The inner lobe terminates in three long setose spines and a setule on the outer anterior margin.

The Maxillipede (Pl. 7. fig. 7).—This appendage is greatly elongated in this genus and characterized by the large epipodite. Miss Richardson has given a figure of the maxillipede, but it is inaccurate in detail. The basipodite is narrow and greatly elongated and has straight inner, outer, and posterior margins. It is longer than the palp, which is five-jointed, the terminal joint being quite small. The inner distal lobe is narrow and the spines on its terminal margin setose. The epipodite is a large, elongated, wide plate extending forward as far as the middle of the third joint of the palp. It is slightly narrower anteriorly than posteriorly, but wider throughout than the basipodite.

6. Pentidotea wosnesenskii (*Brandt*). (Pl. 7. figs. 8, 9.)

Idotea wosnesenskii, Brandt, in Middendorff's Sibirische Reise, vol. ii. (1851) Crust. p. 146.
Idotea hirtipes, Dana, U.S. Expl. Exped. vol. xiv. (II.) (1853) p. 704, pl. 46. fig. 6.
Idotea oregonensis, Dana, Proc. Acad. Nat. Sci. Philad. vol. vii. (1854) p. 175.
Idotea media, Dana, ibid. (1857) p. 175.
Idotea wosnesenskii, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 40; Richardson, Proc. U.S. Nat. Mus. vol. xxi. (1899) p. 846.
Pentidotea wosnesenskii, Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 370, figs. 402–404.

The First Maxilla (Pl. 7. fig. 8).—The outer lobe terminates in twelve stout curved spines, the outermost five being rather stronger than the remaining ones; none of them are denticulate. The inner lobe narrows considerably at its distal end and bears three slender setose spines.

The Maxillipede (Pl. 7. fig. 9).—Miss Richardson has given a figure of the maxillipede, but I find many points of difference. The basipodite is elongated and somewhat shield-shaped, being produced anteriorly at each side of the first joint of the palp and narrowed posteriorly on both the inner and outer margins. It is rather shorter than the length of the palp. All the five joints of the palp are large, the first and fifth being the smallest, the second and third are produced at their anterior margins, the latter more so than the former. The inner distal lobe is wide and surmounted by numerous setose and plain spines. The epipodite is a large wide plate extending forward as far as the commencement of the third joint of the palp. It narrows a little toward the anterior or apical end and is wider than the basipodite.

7. Pentidotea whitei (*Stimpson*). (Pl. 7. figs. 10, 11.)

Idotea whitei, Stimpson, Proc. Acad. Nat. Sci. Philad. (1864) p. 155; Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 42.
Pentidotea whitei, Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 373, figs. 405, 406.

The First Maxilla (Pl. 7. fig. 10).—The outer lobe has twelve terminal spines, the outermost five being stout and curved, the sixth is straighter and more slender, and all the remaining ones, excepting the innermost, have each four or five blunt tooth-like processes. On the ventral surface there is a large setule set in a cup-shaped articular cavity. There are a few setæ on the outer margin. The inner lobe more closely resembles that of *P. resecata* than *P. wosnesenskii*, being wide at its distal end. It has three setose spines, and a short strong setule on its inner anterior margin.

The Maxillipede (Pl. 7. fig. 11).—This appendage resembles somewhat that described in *P. wosnesenskii*, though larger and generally more robust. Miss Richardson's figure does not show the divisions of the coxopodites or

those between the basipodite and the inner distal lobe, and the shape of the former is scarcely correct.

The basipodite is rather shorter and wider than in *P. wosnesenskii* and as wide as the greatest transverse dimension of the epipodite. The five-jointed palp is considerably longer than the basipodite and all the joints wider and longer than in the preceding species, the fifth joint is comparatively much larger than in either of the two species of this genus described above. The inner distal lobe is slightly narrower than in *P. wosnesenskii*, but otherwise very similar. The epipodite is a large flat, elongated plate, narrowing somewhat towards its apical margin, and extending forward to almost the middle of the third joint of the palp.

Glyptidotea, *Stebbing*.

8. Glyptidotea lichtensteini (*Krauss*). (Pl. 7. figs. 12, 13.)

Idotea lichtensteini, Krauss, Südafrik. Crust. 1843, p. 62, pl. iv. fig. 4; Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 64.

Glyptidotea lichtensteini, Stebbing, Sth. Afr. Crust. pt. II. 1902, p. 57, pl. 10.

Stebbing was the first to describe and figure the oral appendages, he states: "First maxillæ.—The outer plate is surmounted by eleven curved spines, the outermost but one being the strongest, the innermost six slender, forming two sets, each consisting of three graduated spines. The inner plate has three plumose setæ on the narrow apex. . . . Maxillipedes.—The inner margin of the first joint forms a rounded process beset with plumose setæ; its external part forms a broad base for the large distally narrowed epipod. The second joint is elongate, its apical process, distally fringed with setæ, reaches beyond the second joint of the palp and somewhat above its base has a strong spine-hook, nearly at the level reached by the apex of the epipod. The first joint of the palp is small, the second widened cup-like, with the inner margin much longer than the outer, the third joint similar but larger, and with less difference between the two margins; the fourth joint is much the longest, oval, but with truncate apex, on which is placed the small, but very distinct, oval fifth joint, this like the three preceding joints having setæ on the inner margin."

With many other writers Mr. Stebbing does not distinguish between the two divisions of the coxopodite, and the inner distal lobe, which is distinct from the basipodite.

The First Maxilla (Pl. 7. fig. 12).—In all the specimens I have examined I find twelve terminal spines on the outer lobe and a large setule, set in a cup-shaped cavity, on the ventral side; further, on the inner lobe, in addition to the three setose spines, there are two setules.

The Maxillipede (Pl. 7. fig. 13).—This appendage in this species shows a strong resemblance to the condition obtaining in the genus *Pentidotea*, only it is less robust and considerably narrower. The divisions of the coxopodite are large and slightly overlap one another. The basipodite is narrow and elongated, with a straight inner margin and narrowest about its middle. The posterior margin slopes upwards and outwards. The five-jointed palp presents all the characteristic features seen in *Pentidotea*, and is half again as long as the basipodite. The inner distal lobe reaches almost to the end of the extended inner margin of the third lobe of the palp. There are a number of setose and plain spines distally of a rather more robust type than in *Pentidotea*. The epipodite proximally is wider than the basipodite, but its distal third narrows considerably, becoming bluntly pointed at its apical margin. It extends forward as far as the anterior outer margin of the second joint of the palp.

It is somewhat doubtful whether or not this species is entitled to separate generic rank or whether it is not synonymous with *Paridotea*, Stebbing. In both genera the palp of the maxillipedes consists of five joints, and the metasome is composed of a single segment and three pairs of sutures. The most striking difference between the two genera is seen, perhaps, in the form of the cephalon.

Idotea, *Fabricius*.

9. Idotea rectilinea, *Lockington*. (Pl. 7. figs. 14, 15.)

Idotea rectilinea, Lockington, Proc. Cal. Acad. Sci. vol. vii. (1877) p. 36; Richardson, Proc. U.S. Nat. Mus. vol. xxii. (1900) p. 131, fig. 5 *c*; Bull. No. 54, U.S. Nat. Mus. 1905, p. 360, figs. 389–391.

The First Maxilla (Pl. 7. fig. 14).—This appendage has not previously been described or figured in this species. The outer lobe terminates in twelve strong curved spines, of which three or four at the inner side are denticulate. The inner lobe has three setose spines and a small curved setule on the ventral outer margin; there are numerous long fine setæ on the inner margin.

The Maxillipede (Pl. 7. fig. 15).—Miss Richardson gives a figure of this appendage in which the coxopodite is shown as a single piece and the general shape is scarcely correct.

The coxopodite consists of two large stout nodules, one lying at the base of the epipodite and the other at the base of the basipodite. In all of the specimens examined these had the large cuboid form shown in fig. 15. The anterior margin of the basipodite is produced slightly on each side of the first joint of the palp. Its inner, outer, and posterior margins are almost straight. The palp is composed of four joints, of which the third is rather smaller than usual. The inner distal lobe has an almost straight anterior

margin, it slopes outwardly, becoming wide at the base. There are a number of setose spines on the anterior margin. The epipodite is slightly narrower than the basipodite. It extends forward slightly beyond the anterior outer margin of the second joint of the palp and becomes a little narrower towards its apical margin.

10. Idotea phosphorea, *Harger*. (Pl. 7. figs. 16–18; Pl. 8. figs. 19–23.)

Idotea phosphorea, Harger with Verrill, Rept. U.S. Comms. F. & F. 1873, pt. 1. p. 569; Harger, ibid. 1880, pt. vi. p. 347, pl. 5. figs. 27–29.
Idotea marina, var. *phosphorea*, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 31.
Idothea phosphorea, Richardson, Bull. U.S. Nat. Mus. 1905, p. 367, figs. 398, 399.

Considerable difference of opinion exists amongst carcinologists as to the specific identity of this species. It was described by Harger in 1873, and in 1880 he gave figures of the animal, the antenna, the maxillipede, the first two walking limbs, the second metasomatic appendage, and the uropod. The original description is as follows:—

"The head is narrowed behind. The eyes are of moderate size. The flagellum of the antennæ is shorter than the peduncle, and consists of about ten to fourteen segments. The maxillipeds have the external lamella broader than in the preceding species [*I. baltica*], with its inner margin straight and its outer margin curving pretty regularly to a slightly attenuated tip.

"The epimera of the second, third, and fourth pairs are rounded behind, and those of the last three pairs are less acute than in *I. baltica* *.

"Pleon ovate, a little constricted near the middle and pointed, its three proximal segments rather less acute than in the preceding species. The basal plate of the operculum tapers towards the end, and the terminal plate is triangular, a little longer than broad. The stylet on the second pair of pleopods in the male is slender, nearly straight, surpasses the lamella to which it is attached, and is obliquely truncate.

"Length 25 mm.; breadth 7 mm."

Miers regarded this species as a variety of *I. baltica* (Pallas), and remarks: "There appears to be no sufficient reason to distinguish *Idotea granulosa* of Rathke . . . . from the American *I. phosphorea*."

Whilst *I. phosphorea* is no doubt closely related to *I. granulosa*, Rathke, which is now regarded as a valid species, I am of opinion that there are sufficient well-defined structural characters which clearly separate it from this latter species. Of these, the most important are, the form of the cephalon, the coxal plates of the mesosome, and the form of the metasome. In addition, the antennules, the antennæ, the first maxillæ, and the maxillipedes also exhibit differences. Finally, in all the specimens of *I. granulosa* that I have examined the dorsal surface of the body never shows tubercles;

* Termed *I. irrorata* by Harger.

it is either finely granulated or almost smooth, whereas in all the specimens of *I. phosphorea* that I have seen there are large lateral and median tubercles. Harger states, "the body, especially of the young, is rough and tubercular along the median line and often, also, laterally. Older specimens are much smoother, losing their large median tubercles, but never becoming as smooth as in" *I. baltica*. I have seen no examples measuring more than 22 mm. in length, and in all of these both the lateral and median tubercles are quite prominent.

A comparison of Sars's figures (**22**, pl. 34. fig. 1) or those given by myself (**12 a**, pl. 5. figs. 48–58) of *I. granulosa*, with those given by Harger (**13**, pl. 5. figs. 27–29) of *I. phosphorea*, at once show the difference in the form of the terminal segment of the metasome, the coxal plates of the mesosome, &c.

In the form of the cephalon (Pl. **8**. fig. 16) the differences from *I. granulosa* are very marked, and are at once apparent in the width and the deep transverse groove, anterior to the posterior margin. The eyes are larger and situated more anteriorly, whilst the lateral margins posterior to the eyes curve inwards.

The antennule (Pl. **8**. fig. 17) is shorter and more robust in this species than in *I. granulosa*, as also the antenna (fig. 18).

In *I. granulosa* I have described (**12 a**) the coxal plates of the mesosome as occupying the anterior two-thirds of the lateral margin of the second segment, the third rather more, and the remainder the whole of the lateral margins, increasing in breadth from the fourth to the seventh segments. Sars (**22**) speaks of them as being "comparatively small."

In *I. phosphorea*, whilst occupying approximately the same proportion of each segment, they are slightly wider, the external margin being more expanded, so that those of the second, third, and fourth segments are roughly triangular, the apex of the triangle being rounded. Those on the fifth, sixth, and seventh segments have a sloping margin from the anterior to the posterior angle, whereas in *I. granulosa* the margins are almost truncate.

Harger (**13**) remarks that young specimens resemble the young of *I. irrorata* (= *baltica*), but that they can be distinguished by the coxal plates of the second and third mesosomatic segments, which do not occupy the whole of the posterior border of the segment. I have compared examples of *I. phosphorea* of from 10 to 15 mm. in length with similar sized specimens of *I. baltica*, but I must confess that I fail to note any resemblance between the two, the general shape and coloration at once serving to separate them.

Although Harger examined large numbers of specimens from twenty different localities, ranging from the New England coast northwards to Halifax, Nova Scotia, and the Gulf of St. Lawrence, and southwards as far as Cape Cod, he never observed a striped pattern of coloration, so common in *I. baltica*, with which species it was found associated, the colour being

usually dark green or brownish, with patches of yellow or whitish, transversely or obliquely arranged.

The First Maxilla (Pl. 8. fig. 19) has the outer lobe strongly curved inwards. There are eleven spines and a fine setule on the ventral surface. Four or five of the innermost spines are denticulate. The inner lobe is fairly large and has three stout setose spines terminally and a setule on the anterior outer margin.

The Maxillipede (Pl. 8. fig. 20).—Of the two figures given by Harger and Richardson of this appendage, that of the former is the better, although both differ considerably from the condition noted in the specimens I have examined. The coxopodite has the two usual divisions. The basipodite is elongated and narrower than the epipodite. The four-jointed palp is half again as long as the basipodite, the first and third joints are small, whilst the second is longer and greatly expanded at the anterior margin on the outer side. The inner distal lobe extends forward almost to the end of the third joint of the palp, terminally it is surmounted with a number of setose and plain spines. The epipodite is shown by Harger with an almost straight inner margin and a narrow, bluntly pointed apical portion lying beneath the third joint of the palp. In all the specimens I have examined, both the inner and outer margins are curved outwards, and with the apical portion slightly narrower and not extending beyond the second joint of the palp.

The metasome (Pl. 8. fig. 22) is composed of two short joints, a single suture, and the large terminal segment. This latter is more triangular than in *I. granulosa*, rather shorter, and shows a faint constriction about its middle, then widening slightly, it terminates somewhat abruptly in a sharp point.

The uropod (Pl. 8. fig. 23) is characterized by the triangular-shaped endopodite, which is rather longer than wide.

Paridotea, *Stebbing*.

11. Paridotea ungulata (*Pallas*). (Pl. 8. figs. 24, 25.)

Oniscus ungulatus, Pallas, Spicil. Zool. vol. ix. (1772) p. 62, pl. 4. fig. 11.
Idotea ungulata, Lamarck, Hist. Anim. sans Vert. vol. v. (1818) p. 160.
Idotea lalandii, Milne-Edwards, Hist. Nat. Crust. vol. iii. (1840) p. 132, pl. 31. fig. 7; Krauss, Südafrik. Crust. 1843, p. 61.
Idotea affinis, Milne-Edwards, Hist. Nat. Crust. vol. iii. (1840) p. 133; Krauss, Südafrik. Crust. 1843, p. 61.
Idotea edwardsii, Guérin-Méneville, Icon. Règne Anim. 1829–44, Crust. p. 33.
Idotea nitida, Heller, Verhandl. zool.-bot. Ges. Wien, 1861, p. 497.
? *Idotea excavata*, Haswell, Proc. Linn. Soc. N.S.W. vol. vi. (1882) p. 2.

Idotea ungulata, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 52; Chilton, Trans. New Zealand Inst. vol. xxii. (1890) p. 196.
Paridotea ungulata, Stebbing, Sth. Afr. Crust. 1900, pt. i. p. 53.

The only two references to the oral appendages of this species are a figure of the mandible and the maxillipedes given by Milne-Edwards, and a short description of all the appendages by Stebbing. In this latter account the author remarks: "The first maxillæ have six strongly plumose setæ on the narrow inner plate, and ten short apical spines on the outer." In the description of the maxillipede the palp is spoken of as consisting of *four* joints. As will be seen from the following description and accompanying figures, I find many differences from Mr. Stebbing's account.

The First Maxilla (Pl. 8. fig. 24).—This appendage is very large in this species. The outer lobe has five stout curved spines on the outer side, then a thin fine curved one and a further six, not so strong as those on the outer side; there is also a long setule, set in a cup-shaped cavity, on the ventral surface. The inner lobe is wide and has four stout setose spines terminally, and a small setule on the middle of the ventral surface close to the anterior margin. In none of the nine specimens examined was any variation in the number of spines observed.

The Maxillipede (Pl. 8. fig. 25).—This appendage is considerably elongated in this genus. The two divisions of the coxopodite are small, as also the basipodite, which posteriorly terminates in a blunt point, with a straight outer margin; anteriorly it flanks the first joint of the palp on both sides; the outer margin gradually curves inwards towards the posterior end. The palp is nearly twice the length of the basipodite. The first joint is small, the second more elongated and slightly expanded laterally, the third joint is still longer and more expanded laterally particularly on the inner side, the fourth joint is the longest, and this and the smaller terminal joint are both densely setose on their inner margins. There are also a few setæ on the inner margin of the third and second joints. The inner distal lobe extends forward as far as the middle of the third joint of the palp. It has an outwardly sloping anterior margin from which arise a number of setose spines; there are three coupling-hooks towards the base of the inner margin. The epipodite posteriorly is wider than the basipodite, narrowing anteriorly, and then sloping inwardly its apical portion terminates in a blunt point. It extends forward to about the middle of the third joint of the palp.

PARIDOTEA UNGULATA (*Pallas*) var. nov. ATROVIRENS.

Whole of the body a very dark olive-green, almost black. Length 40 mm.

Hab. Shore-pools, Brighton, Victoria, Australia: Dec. 18, 1893 (*J. J. Lister*).

Type. In the University Museum of Zoology, Cambridge.

12. PARIDOTEA RETICULATA, *Barnard*. (Pl. 8. figs. 26, 27.)

Paridotea reticulata, Barnard, Ann. Sth. Afr. Mus. vol. x. (1914) p. 424, pl. 36 D.

Barnard, in describing this beautiful species, states: "The mouth-parts resemble those of *P. ungulata*, except that the lateral margins of the epistome are angular, not evenly convex, and the inner lobe of the first maxilla has only three plumose setæ."

The First Maxilla (Pl. 8. fig. 26).—The outer lobe terminates in twelve spines, three or four of the innermost being denticulate. The inner lobe is narrower than in *P. ungulata* and has only three terminal setose spines and a single setule on the anterior outer margin.

The Maxillipede (Pl. 8. fig. 27).—Whilst bearing a strong resemblance to the maxillipede of *P. ungulata*, this appendage in *P. reticulata* is rather more robust and setose. The basipodite is wider on its posterior margin and more obliquely cut away anteriorly. The second joint of the palp is smaller than in *P. ungulata* and the third longer and wider. The epipodite is about the same width as the basipodite, but narrows considerably towards its apical end. The whole appendage is densely setose, and there are a series of strong spines on the outer expanded margin of the third joint of the palp.

13. PARIDOTEA RUBRA, *Barnard*. (Pl. 8. figs. 28, 29.)

Paridotea rubra, Barnard, Ann. Sth. Afr. Mus. vol. x. (1914) p. 426, pl. 37 A.

The mouth-parts of this species have not hitherto been figured. Barnard's description is brief—he states: "First maxilla, outer plate with ten spines, the two innermost denticulate, inner plate with three plumose setæ. . . . Maxillipede seven-jointed, epipod reaching to the end of the fourth joint, apex incurved."

The First Maxilla (Pl. 8. fig. 28).—The outer lobe terminates in ten spines, the outermost one is smaller than the second one, and the two innermost are faintly denticulate; the inner lobe is narrow and has three setose spines and a prominent setule.

The Maxillipede (Pl. 8. fig. 29).—The two divisions of the coxopodite are small. The basipodite is narrow and elongated, with both inner and outer margins almost straight, the posterior margin is obliquely cut away towards the epipodite, anteriorly the segment flanks the first joint of the palp on both sides. The five-jointed palp is typical of the genus. The inner distal lobe is rather longer than in the preceding species. The epipodite is slightly narrower than the basipodite, excepting at its base; it is curved inwards anteriorly and extends as far as the middle of the third joint of the palp, not to the end of the fourth joint as stated by Barnard.

14. Paridotea fucicola, *Barnard*. (Pl. 8. figs. 30, 31.)

Paridotea fucicola, Barnard, Ann. Sth. Afr. Mus. vol. x. (1914) p. 427, pl. 36 E.

Barnard has figured the maxillipede, but not altogether satisfactorily.

The First Maxilla (Pl. 8. fig. 30).—This appendage differs from that in *P. rubra* in having more denticulate spines on the outer lobe and in the presence of a long setule on the inner ventral surface. It is also densely setose on both the inner and the outer margins, the setæ on the inner margin being strong and spine-like. The inner lobe differs only in the position of the setule, which in this species is smaller and situated on the outer anterior margin.

The Maxillipede (Pl. 8. fig. 31).—Excepting that it is much smaller and not so elongated, the maxillipede is very like that of *P. rubra*.

Euidotea, gen. nov.

Body narrow-oblong, not keeled, and nearly smooth. Cephalon anteriorly emarginate, lateral lobes somewhat prominent. Maxillipedes with a palp composed of four joints. Coxal plates narrow, in the second, third, and fourth mesosomatic segments they occupy a little more than half of the lateral margins, in the fifth they occupy almost the whole of the lateral margins, and in the sixth and seventh segments extend from the anterior to the posterior angle. Metasome composed of a single segment and three lateral sutures.

15. Euidotea peronii (*Milne-Edwards*). (Pl. 8. figs. 32, 33.)

Idotea peronii, Milne-Edwards, Hist. Nat. Crust. vol. iii. (1840) p. 133; Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 55; Chilton, Trans. New Zealand Inst. vol. xxii. (1890) p. 199.

Idotea distincta, Guérin-Méneville, Icon. Règne Anim. 1829–44, Crust. p. 33.

Idotea stricta, Dana, U.S. Expl. Exped. 1853, Crust. ii. p. 704, pl. 46. fig. 7; Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 62.

Idotea caudacuta, Haswell, Proc. Linn. Soc. N.S.W. vol. vi. (1882) p. 1, pl. 4. fig. 4.

Paridotea peronii, Stebbing, Ann. Sth. Afr. Mus. vol. vi. (1910) p. 433.

This species was placed by Stebbing (24, p. 433) in the genus *Paridotea*, but an examination of the oral appendages at once shows that it cannot remain there, neither can it be placed in the genus *Idotea*, Fabr.; I have, therefore, proposed for its reception the new genus *Euidotea*.

The First Maxilla (Pl. 8. fig. 32).—The outer lobe terminates in twelve stout spines, free of any denticulation, and a single fine spine; the inner lobe has three setose spines, and three setules on its ventral surface.

The Maxillipede (Pl. 8. fig. 33).—There are two somewhat large divisions of the coxopodite. The basipodite is rather short, but on its inner side extends for some little distance beyond the first joint of the palp. It is about

the same width as the epipodite and shorter than the palp. The four-jointed palp has the first joint small, the second joint longer than the third though not so expanded laterally, and the fourth joint considerably larger and oval in shape. The inner distal lobe is elongated, extending almost to the end of the third joint of the palp; terminally it has some strongly developed plain spines and a number of setose ones. The epipodite extends just beyond the anterior margin of the second joint of the palp.

Erichsonella, *Benedict.*

16. Erichsonella attenuata (*Harger*). (Pl. 8. fig. 34; Pl. 9. fig. 35.)

Erichsonia attenuata, Harger with Verrill, Rpt. U.S. Comms. F. & F. 1873, pt. I. p. 570, pl. 6. fig. 27; Harger, ibid. 1880, pt. VI. p. 356, pls. 6, 7. figs. 36, 37.

Erichsonella attenuata, Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 400, figs. 447, 448.

The First Maxilla (Pl. 8. fig. 34).—The outer lobe terminates in ten spines, the middle ones being the largest, two or three of the innermost are faintly denticulate. The inner lobe has the anterior margin sloping inwardly and has sometimes four and sometimes three setose spines and a setule on the outer margin; the inner margin is setose.

The Maxillipede (Pl. 9. fig. 35).—Miss Richardson's figure shows three divisions of the coxopodite, but I have failed to find more than two. The basipodite is rather short and a little narrower than the epipodite. The palp has four wide joints, the first being small and the second and third cup-shaped and gradually enlarging, their inner margins are widely expanded, the fourth joint (the largest) is oval in shape. The setæ are small and few in number. The inner distal lobe extends almost as far as the anterior margin of the third joint of the palp. The epipodite is almost truncate at its posterior margin and narrows a little anteriorly and extends just beyond the middle of the third joint of the palp.

Synoptic Key to the Species of the Genus Synidotea.

A. Terminal segment of metasome emarginate or notched.
  a. Lateral cephalic lobes well developed.
    b. Frontal spines overhanging frontal lobe.
      c. Outline of metasome triangular ..... *S. hirtipes* (Milne-Edw.). / *S. pallida*, Benedict.
    b'. Frontal spines absent.
      c'. Outline of metasome subparallel..... *S. nebulosa*, Benedict.
      c''. Outline of metasome arcuate ..... *S. angulata*, Benedict.
      c'''. Outline of mesosome subtriangular.
        d. Outline of metasome subparallel ..... *S. marmorata* (Packard).
        d'. Outline of mesosome strongly arcuate ..... *S. bicuspida* (Owen).

B. Terminal segment of metasome produced as a blunt spine.
  a. Lateral cephalic lobes small.
    b. Frontal spines not on the margin ..... *S. nodulosa* (Kröyer).
    b'. Frontal spines on the margin ..... *S. lævis*, Benedict.

Synidotea, *Harger*.

17. Synidotea hirtipes (*Milne-Edwards*). (Pl. 9. figs. 36, 37.)

Idotea hirtipes, Milne-Edwards, Hist. Nat. Crust. vol. iii. (1840) p. 134; Krauss, Südafrik. Crust. 1843, p. 61.
Edotia hirtipes, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 68.
Synidotea hirtipes, Benedict, Proc. Acad. Nat. Sci. Philad. 1897, p. 403; Stebbing, Sth. Afr. Crust. 1902, pt. ii. p. 60.

Stebbing has described the oral appendages of this species in great detail. He states: "The first maxillæ have the outer plate surmounted by ten or sometimes eleven spines, some of which are denticulate, none very powerful. The inner plate is narrow at both ends, and has at the apex only two setæ, which are rather long, and, as usual, setose.

"The maxillipedes have the first joint short, the epipod nearly parallel-sided, not reaching the apex of the process of the second joint, though extending considerably beyond the first joint of the palp; its upper margin slopes inward. The process of the second joint is shaped as commonly in the Amphipoda Gammaridea, and similarly fringed with setæ on the inner and apical margins, but here it is tied to its fellow, each member of the pair carrying a strong spine-hook for grappling the other. The first joint of the palp is small and rather obscure, the second is very large, widening distally, its distal margin flatly rounded on the inner part and externally forming a little free projection. The third joint is also very large, its inner margin almost continuous with that of the preceding joint, feebly convex, fringed with short spines, its outer margin strongly convex, fringed with setæ-like spines, some of which also stand out from the surface."

The First Maxilla (Pl. 9. fig. 36).—In none of the specimens that I have examined have there been more than ten spines on the outer lobe, in addition to which there is a long setule set in a cup-shaped cavity on the ventral surface of the lobe. In a like manner there are three setules on the ventral surface of the narrow inner lobe, the two setose spines of which are rather longer than in most species.

The Maxillipede (Pl. 9. fig. 37).—This appendage in the genus *Synidotea* is characterized by the large size of the second and third lobes of the palp. In *S. hirtipes* the two divisions of the coxopodite are small. The basipodite has both its inner and outer margins almost straight, the posterior and anterior ones slope outwards. The three-jointed palp is almost twice the length of the inner margin of the basipodite. The first joint is small, the

second and third joints are very large. The inner distal lobe extends forward slightly beyond the middle of the second joint of the palp, and distally it has a number of setose spines. The epipodite is a wide flattened plate, with almost parallel sides ; it is wider than the basipodite. Its apical portion curves outwardly slightly and extends forward as far as a point a little beyond the middle of the second joint of the palp.

18. SYNIDOTEA PALLIDA, *Benedict.* (Pl. 9. figs. 38, 39.)

Synidotea pallida, Benedict, Proc. Acad. Nat. Sci. Philad. 1897, p. 396; Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 378, figs. 412, 413.

The First Maxilla (Pl. 9. fig. 38).—The outer lobe exhibits a strong inward curve. It has eight terminal spines, all of which are denticulate, and there are a few setæ on the inner anterior margin. The inner lobe is comparatively small ; terminally there are two long setose spines.

The Maxillipede (Pl. 9. fig 39).—Miss Richardson's figure of the maxillipede of this species is incomplete and very unlike the actual appendage. The divisions of the coxopodite are small. The basipodite is small, but does not slope outward quite so much as in the preceding species, and the second joint of the palp is smaller, the third joint is twice the length of the second one ; the inner distal lobe is also narrower than in *S. hirtipes.* The epipodite is a wide flattened plate with its apical portion narrowed and sloping outwards ; it extends as far forward as the anterior margin of the second joint of the palp.

19. SYNIDOTEA NEBULOSA, *Benedict.* (Pl. 9. figs. 40, 41.)

Synidotea nebulosa, Benedict, Proc. Acad. Nat. Sci. Philad. 1897, p. 397 ; Richardson, Proc. U.S. Nat. Mus. vol. xxi. (1899) p. 848; Bull. No. 54, U.S. Nat. Mus. 1905, p. 381, figs. 416, 417.

The First Maxilla (Pl. 9. fig. 40).—The outer lobe has a strong inward curve. There are ten terminal spines, most of which are denticulate ; there are a few setæ on both the outer and inner margins. The anterior portion of the inner lobe is roughly triangular with the distal end obliquely cut away and terminating in two stout setose spines.

The Maxillipede (Pl. 9. fig. 41).—The shape of the basipodite at once serves to separate this species from any other member of the genus. The second joint of the palp is very large, but the anterior lateral margins are not so expanded as in *S. hirtipes.*

20. SYNIDOTEA ANGULATA, *Benedict.* (Pl. 9. figs. 42, 43.)

Synidotea angulata, Benedict, Proc. Acad. Nat. Sci. Philad. 1897, p. 395; Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 382, figs. 418, 419.

The First Maxilla (Pl. 9. fig. 42).—The strong inner curve of the outer

lobe is not so pronounced in this species. There are ten terminal spines, most of which are faintly denticulate. The anterior portion of the inner lobe is oval in shape with two setose spines, longer and more slender than those of *S. nebulosa*.

The Maxillipede (Pl. 9. fig. 43) agrees very closely with that of *S. nebulosa*, excepting that it is more robust and larger. The third lobe of the palp is more stunted and the basipodite much longer.

21. Synidotea marmorata (*Packard*). (Pl. 9. figs. 44, 45.)

Idotea marmorata, Packard, Mem. Bost. Soc. Nat. Hist. vol. i. (1867) p. 296, pl. 8. fig. 6.
Idotea bicuspida, Streets & Kingsley, Bull. Essex Inst. vol. ix. (1877) p. 108.
Synidotea bicuspida, Harger, Proc. U.S. Nat. Mus. vol. ii. (1879) p. 160; Rept. U.S. Comms. F. & F. 1880, pt. vi. p. 352.
Edotia bicuspida, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 66.
Synidotea marmorata, Benedict, Proc. Acad. Nat. Sci. Philad. 1897, p. 392; Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 384, figs. 422, 423.

The First Maxilla (Pl. 9. fig. 44).—Both of the lobes in this species are comparatively small. The outer one is abruptly narrowed posteriorly; anteriorly there are eight spines, all of which are denticulate. Setæ are present on both the inner and outer margins for a short distance.

The Maxillipede (Pl. 9. fig. 45).—This appendage bears a strong resemblance to that of *S. nebulosa*; there are, however, slight differences in the form of the basipodite and the second lobe of the palp.

22. Synidotea bicuspida (*Owen*). (Pl. 9. figs. 46, 47.)

Idotea bicuspida, Owen, Crust. of the 'Blossom,' 1839, p. 92, pl. 27. fig. 6.
Idotea pulchra, Lockington, Proc. Cal. Acad. Sci. vol. vii. (1877) p. 44.
Synidotea incisa, G. O. Sars, Crust. et Pycnog. nova etc., 1880, no. 8.
Edotia bicuspida, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 66.
Synidotea bicuspida, G. O. Sars, Crust. Norweg. Nth. Atlantic Exp. 1885, vol. i. p. 116, pl. 10. figs. 24–26; Benedict, Proc. Acad. Nat. Sci. Philad. 1897, p. 391; Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 385, fig. 424.

The oral appendages of this species have not previously been described or figured. They exhibit a relationship to *S. marmorata*, but differ from those in that species in being larger and of a more robust type.

The First Maxilla (Pl. 9. fig. 46).—The outer lobe is somewhat thickened and has ten spines, most of which are denticulate; there are a few setæ on the inner anterior margin. As in *S. marmorata*, the anterior end of the inner lobe is somewhat triangular in shape, but the inner margin is almost straight. There are two long setose spines, and a setule on the anterior inner margin.

The Maxillipede (Pl. 9. fig. 47).—The form of this appendage in *S. bicuspida* approaches very closely to that found in *S. pallida*, only it is much larger and the third lobe of the palp is comparatively smaller, and also shorter than the second joint.

23. Synidotea nodulosa (*Kröyer*). (Pl. 9. figs. 48, 49.)

Idotea nodulosa, Kröyer, Naturhist. Tidsskrift, vol. ii. (1846) p. 100; Voy. en Scand. Crust. 1849, pl. 26. fig. 2.

Synidotea nodulosa, Harger, Rept. U.S. Comms. F. & F. 1886, pt. vi. p. 351, pl. 6. figs. 33–35.

Edotia nodulosa, Miers, Journ. Linn. Soc., Zool. vol. xvi. (1881) p. 67.

Synidotea nodulosa, Benedict, Proc. Acad. Nat. Sci. Philad. 1897, p. 398; Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 388, figs. 429, 430.

The First Maxilla (Pl. 9. fig. 48).—There are ten sharply pointed spines on the outer lobe, the three most ventral of which are denticulate; the inner lobe has two long setose spines and a single setule on the anterior outer margin.

The Maxillipede (Pl. 9. fig. 49) agrees very closely with that of *S. bicuspida*; the epipodite, however, is rather longer and has its apical portion more pointed. The inner margin of the basipodite anteriorly is produced into a number of serrations.

24. Synidotea lævis, *Benedict*. (Pl. 9. figs. 50, 51.)

Synidotea lævis, Benedict, Proc. Acad. Nat. Sci. Philad. 1897, p. 399; Richardson, Bull. No. 54, U.S. Nat. Mus. 1905, p. 389, figs. 431, 432.

The First Maxilla (Pl. 9. fig. 50).—The outer lobe has a well-marked slope on its outer side and has eight terminal spines, two or three of which are denticulate; the inner lobe is somewhat triangular anteriorly, as in *S. nebulosa*, and has two long setose spines.

The Maxillipede (Pl. 9. fig. 51).—This appendage in this species is characterized by the great development of the second joint of the palp. It is the longest of the three, and anteriorly considerably wider than long, owing to the great expansion of the anterior lateral margins. The epipodite is similar in shape to that in *S. marmorata*, only somewhat shorter. The inner margin of the basipodite is anteriorly continued forward for some little distance beyond the first joint of the palp.

VI. Bibliography.

1. Barnard, K. H.—Contributions to the Crustacean Fauna of South Africa. I. Additions to the Marine Isopoda. Ann. Sth. Afr. Mus. vol. x. (1914) pp. 197–230, pls. 17–22.
2. —— III. Additions to the Marine Isopoda, with notes on some previously incompletely known species. *Ibid.* pp. 325 *a*–358 *a* & 359–442, pls. 27–38.
3. Benedict, J. E.—A Revision of the Genus *Synidotea*. Proc. Acad. Nat. Sci. Philad. (1897) pp. 389–404.
4. —— Two new Isopods of the Genus *Idotea* from the Coast of California. Proc. Biol. Soc. Washington, vol. xii. (1898) pp. 53–55, figs. 12, 13.
5. Chilton, Chas.—On a new Species of *Idotea*. Ann. & Mag. Nat. Hist. (s. 5) vol. xv. (1885) pp. 123, 124, pl. 5 A. figs. 1–3.
6. —— Revision of the New Zealand Idoteidæ. Trans. New Zealand Inst. vol. xxii. (1890) pp. 189–204.
7. Collinge, Walter E.—On the Range of Variation of the Oral Appendages in some Terrestrial Isopods. Journ. Linn. Soc., Zool. vol. xxxii. (1914) pp. 287–293, pls. 20, 21.
8. —— Description of a new Species of Marine Isopod of the Genus *Pentias*, Richardson. Journ. Zool. Research, vol. i. (1916) pp. 33–35, pl. 3.
9. —— On the Marine Isopod *Idotea ochotensis*, Brandt. *Ibid.* pp. 82–85, pl. 4.
10. —— On the Structure of the Marine Isopod *Mesidotea sibirica* (Birula), with some Remarks upon Allied Genera. *Ibid.* pp. 112–118, pl. 5.
11. —— A Note on the Marine Isopod *Idotea elongata*, Miers. *Ibid.* pp. 119, 120.
12. —— Some Remarks upon the Structure and Generic Position of *Idotea lacustris*, Thomson. *Ibid.* pp. 153–157, pl. 6.

12 a. —— A Revision of the British Idoteidæ, a Family of Marine Isopoda. Trans. Roy. Soc. Edinb. vol. li. (1917) pp. 721–760, pls. 1–11.

13. Harger, Oscar.—Report on the Marine Isopoda from New England and adjacent Waters. Rept. U.S. Comms. Fish & Fisheries for 1878, pt. vi. 1880, pp. 297–462, pls. 1–13.
14. Haswell, W.—On some new Australian Marine Isopoda. Pt. II. Proc. Linn. Soc. N.S.W. vol. vi. (1881) pp. 181–196, pls. 3, 4.
15. Kröyer, H.—Karcinologiste Bidrag. Naturh. Tidsskr. vol. xi. (1846–49) II. pp. 1–123, 366–446.
16. Miers, E. J.—Revision of the Idoteidæ, a family of Sessile-eyed Crustacea. Journ. Linn. Soc., Zool. vol. xvi. (1881) pp. 1–88, pls. 1–3.

17. Milne-Edwards, H.—Histoire naturelle des Crustacés. Paris, t. iii. (1840) pp. 115–284, pls. 31–33.
18. Ohlin, Axel.—Isopoda from Tierra del Fuego and Patagonia. I. Valvifera. Svenska Exped. till Magellan. Bd. ii. (1907) pp. 261–306, pls. 20–25.
19. Racovitza, E. G., and Sevastos, R.—*Proidotea haugi*, n. g. n. sp., Isopode oligocène de Roumanie et les Mesidoteini nouvelle sous-famille des Idotheidæ. Arch. Zool. exp. et gén. s. 5, t. vi. (1910) pp. 175–200, pls. 9, 10.
20. Richardson, Harriet.—A Monograph of the Isopods of North America. Bull. No. 54, U.S. Nat. Mus. 1905, pp. liii + 727, & 740 figs.
21. —— Description of a new Genus and Species of Isopod Crustacean of the Family Idotheidæ, from the Mouth of the Rio de la Plata, Argentina, South America. Proc. U.S. Nat. Mus. vol. xl. (1911) pp. 169–171, figs. 1–4.
22. Sars, G. O.—Account of the Crustacea of Norway. Vol. II. Isopoda. 1897.
23. Stebbing, T. R. R.—South African Crustacea. Pt. I., 1902, pp. 14–66, pls. 1–4 (publ. July 20th, 1900). Pt. II., 1904, pp. 1–92, pls. 5–16 (publ. Oct. 7th, 1902). Marine Investigations in South Africa.
24. —— General Catalogue of South African Crustacea. Ann. Sth. Afr. Mus. vol. vi. (1910) pp. 281–593, pls. 15–22.

EXPLANATION OF THE PLATES.

No attempt has been made to introduce the exact number of setæ into the different figures.

Plate 7.

Fig. 1. *Chiridotea cæca* (Say). Ventral view of the right maxillipede. × 38.
2. —— *tuftsii* (Stimpson). Ventral view of the left maxillipede. × 38.
3. *Mesidotea sabini* (Kröyer). Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 19.
4. —— —— Ventral view of the terminal portion of the second maxilla. × 19.
5. —— —— Ventral view of the right maxillipede. × 9.
6. *Pentidotea resecata* (Stimpson). Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 19.
7. —— —— Ventral view of the left maxillipede. × 7·5.
8. —— *wosnesenskii* (Brandt). Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 19.
9. —— —— Ventral view of the right maxillipede. × 19.
10. —— *whitei* (Stimpson). Ventral view of the terminal portions of the inner and outer lobes of the left first maxilla. × 38.
11. —— —— Ventral view of the left maxillipede. × 19.

Fig. 12. *Glyptidotea lichtensteini* (Krauss). Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 38.
13. —— —— Ventral view of the left maxillipede. × 12.
14. *Idotea rectilinea*, Lockington. Ventral view of the terminal portions of the inner and outer lobes of the left first maxilla. × 38.
15. —— —— Ventral view of the right maxillipede. × 19.
16. —— *phosphorea*, Harger. Dorsal view of the cephalon.
17. —— —— Dorsal view of the right antennule. × 38.
18. —— —— Dorsal view of the left antenna. × 21·5.

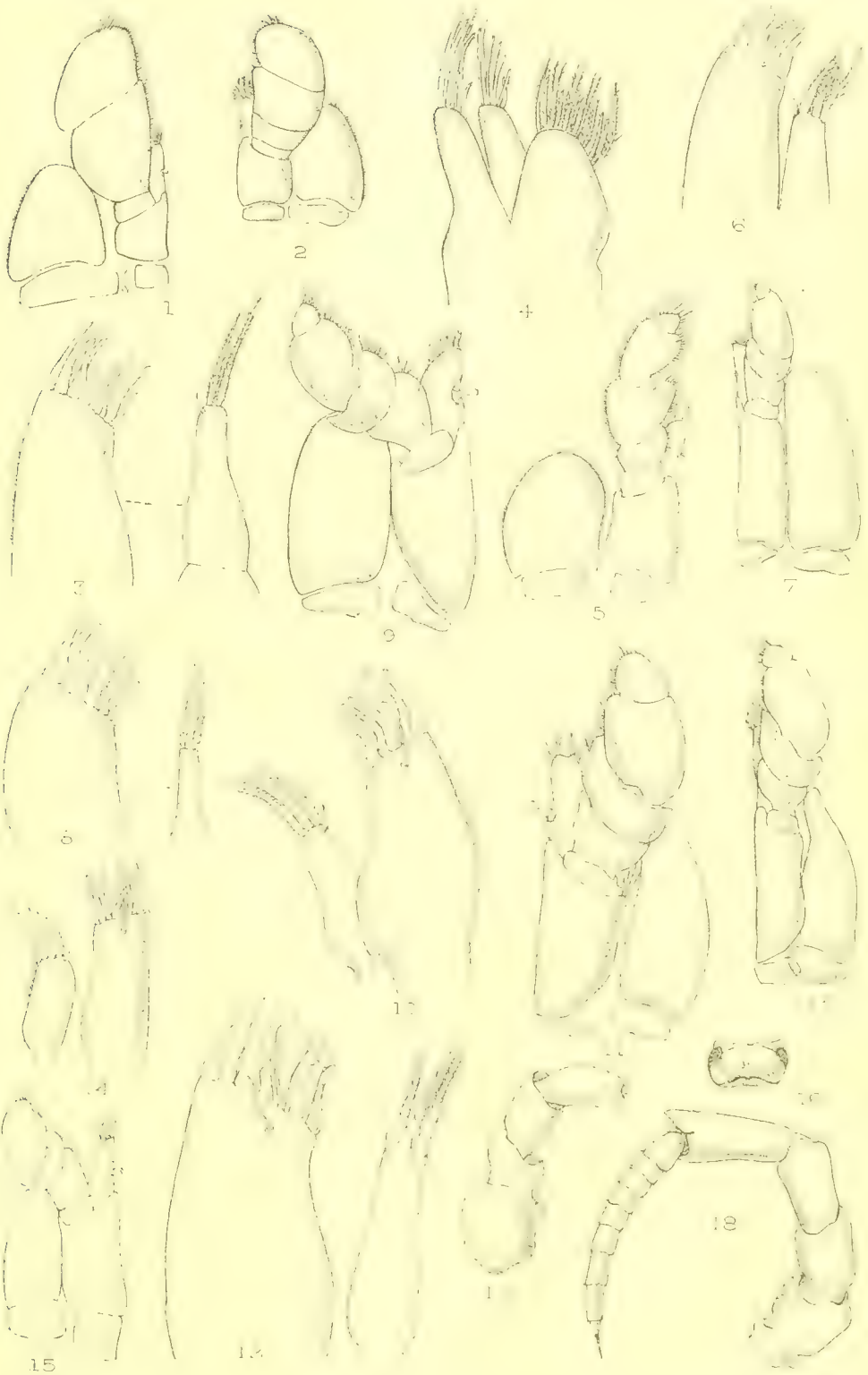
Plate 8.

Fig. 19. *Idotea phosphorea*, Harger. Ventral view of the terminal portions of the inner and outer lobes of the left first maxilla. × 78.
20. —— —— Ventral view of the left maxillipede. × 38.
21. —— —— Dorsal view of the lateral portions of the mesosomatic segments, showing the coxal plates.
22. —— —— Dorsal view of the metasome. × 3·5.
23. —— —— Left uropod. × 10.
24. *Paridotea ungulata* (Pallas). Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 38.
25. —— —— Ventral view of the right maxillipede. × 9·5.
26. —— *reticulata*, Barnard. Ventral view of the terminal portions of the inner and outer lobes of the left first maxilla. × 38.
27. —— —— Ventral view of the left maxillipede. × 9·5.
28. —— *rubra*, Barnard. Ventral view of the terminal portions of the inner and outer lobes of the left first maxilla. × 38.
29. —— —— Ventral view of the left maxillipede. × 12.
30. —— *fucicola*, Barnard. Ventral view of the terminal portions of the inner and outer lobes of the first maxilla. × 24.
31. —— —— Ventral view of the left maxillipede. × 24.
32. *Euidotea peronii* (Milne-Edwards). Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 38.
33. —— —— Ventral view of the right maxillipede. × 14.
34. *Erichsonella attenuata* (Harger). Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 75.

Plate 9.

Fig. 35. *Erichsonella attenuata* (Harger). Ventral view of the right maxillipede. × 38.
36. *Synidotea hirtipes* (Milne-Edwards). Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 38.
37. —— —— Ventral view of the left maxillipede. × 16.
38. —— *pallida*, Benedict. Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 38.
39. —— —— Ventral view of the right maxillipede. × 18.
40. —— *nebulosa*, Benedict. Ventral view of the terminal portions of the inner and outer lobes of the left first maxilla. × 38.
41. —— —— Ventral view of the left maxillipede. × 19.
42. —— *angulata*, Benedict. Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 38.

Collinge. JOURN. LINN. SOC. ZOOL. VOL. ~~XXXIII. PL 7.~~

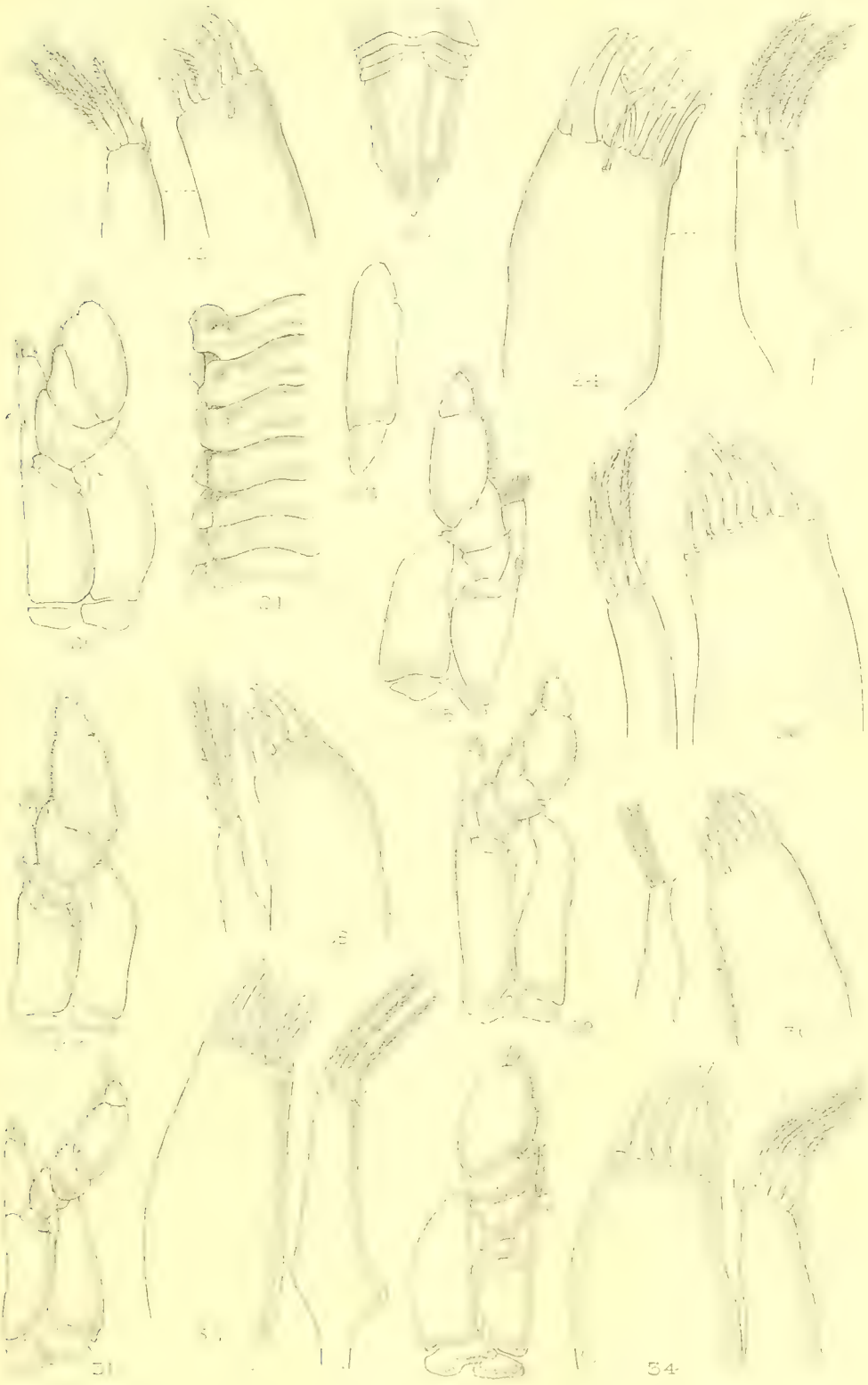


Æ. J. J. del. ad. nat.

C. Hodges & Son. lith. & imp.

ORAL APPENDAGES OF ISOPODA.

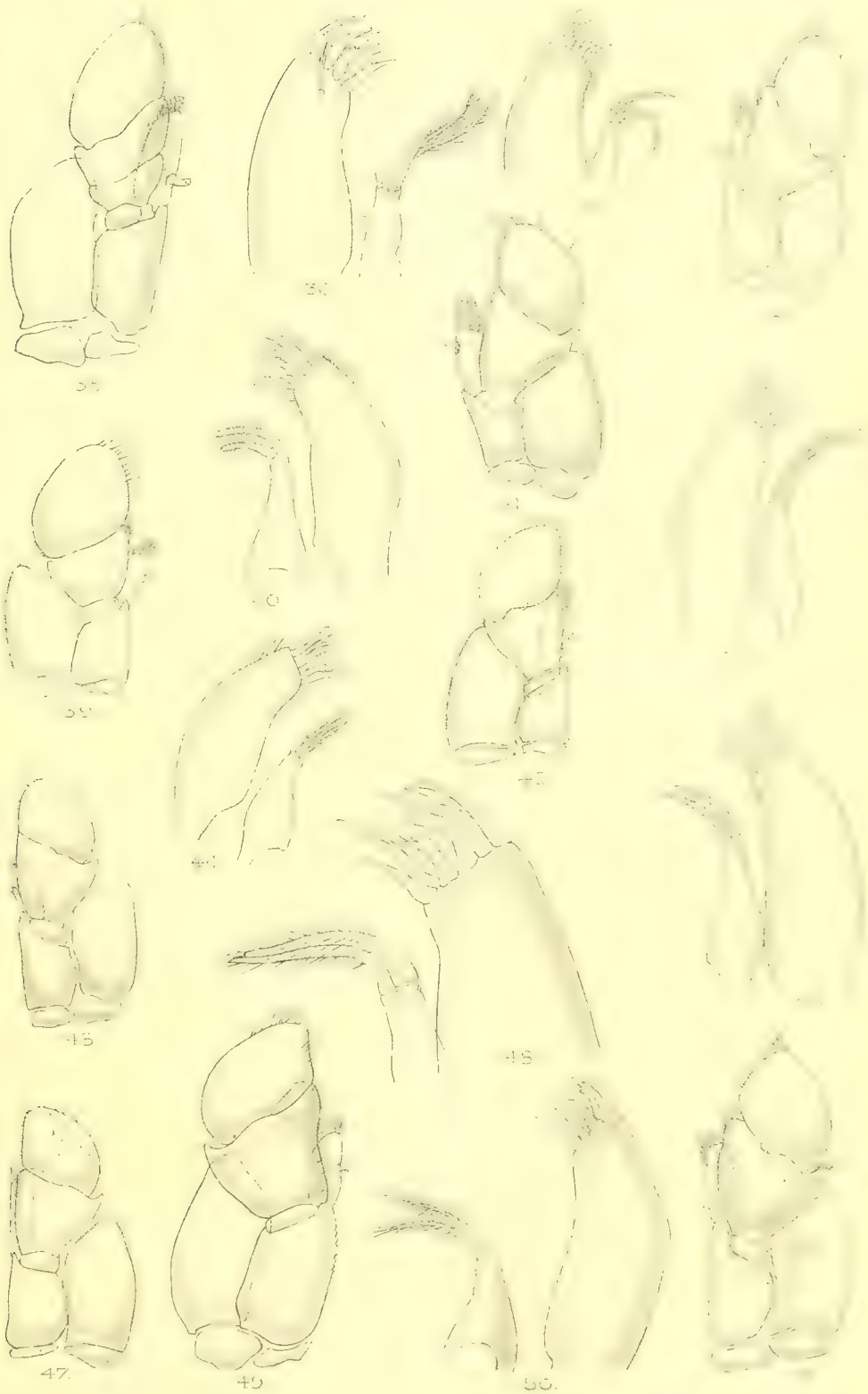
Collinge. Journ. Linn Soc. Zool. Vol. ~~XXVIII. P. L. 8.~~



Æ. J.J del. ad nat. C Hodges & Son. lith & imp.

ORAL APPENDAGES OF ISOPODA.

Collinge Journ Linn. Soc. Zool Vol. ~~XXVIII P.L.9.~~



Æ.J.J. del ad nat. C.Hodges & Son. lith. & imp.

ORAL APPENDAGES OF ISOPODA.

Fig. 43. *Synidotea angulata*, Benedict. Ventral view of the left maxillipede. × 12.
44. —— *marmorata* (Packard). Ventral view of the terminal portions of the inner and outer lobes of the right first maxilla. × 38.
45. —— —— Ventral view of the right maxillipede. × 19.
46. —— *bicuspida* (Owen). Ventral view of the terminal portions of the inner and outer lobes of the left first maxilla. × 26.
47. —— —— Ventral view of the left maxillipede. × 10.
48. —— *nodulosa* (Kröyer). Ventral view of the terminal portions of the inner and outer lobes of the left first maxilla. × 100.
49. —— —— Ventral view of the right maxillipede. × 38.
50. —— *lævis*, Benedict. Ventral view of the terminal portions of the inner and outer lobes of the left first maxilla. × 38.
51. —— —— Ventral view of the left maxillipede. × 19.

The author desires to thank the Carnegie Trust for the Universities of Scotland for a grant to defray artists' charges.